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7th Smart Grids & Cleanpower 2016
Cambridge 27-28 June
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Smart Grids Cleanpower 2016

Energy Storage Optimisation – A proven business case

AMT-Sybex

Georgina Dingley

June 2016

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Agenda:

- Introduction to AMT-Sybex and Networkflow FOSS
- Smarter Network Storage project
- Water Companies – Why Energy Storage?
- The case for DNO ownership
- Summary

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Introduction to AMT-Sybex

2016

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AMT-SYBEX - Clients

"Essential Industries"

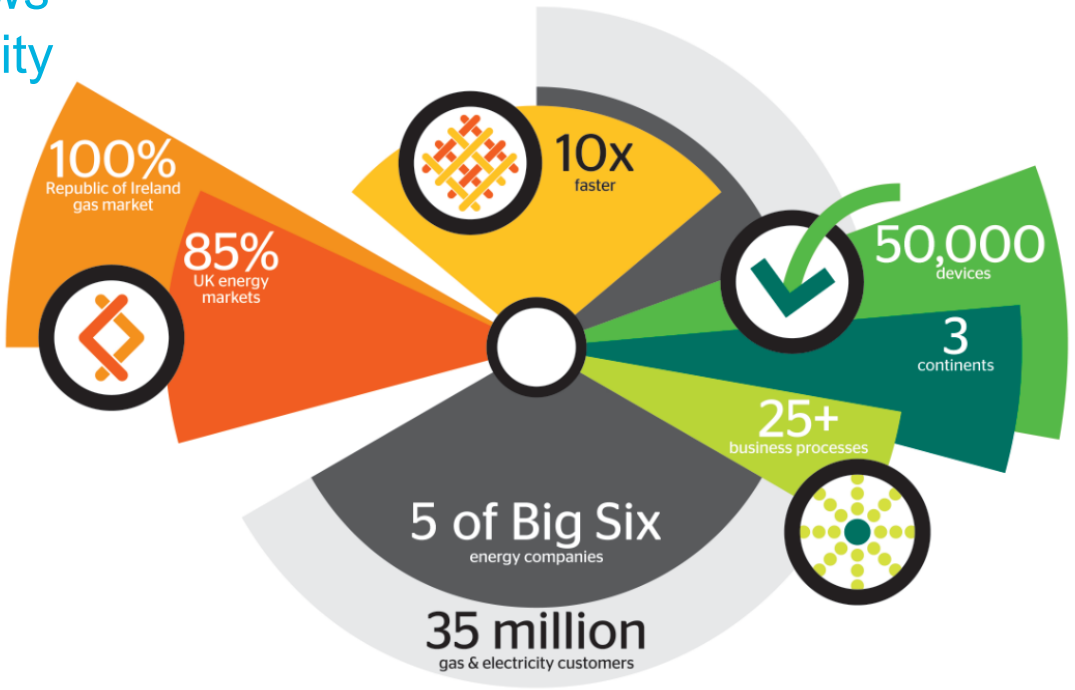
- Similar customer, stakeholder/shareholder needs
- Utilities and Infrastructure clients
- Long-term partnerships
- High performing solutions supporting critical operations

Affinity Suite®

Our powerful and flexible enterprise suite helps you manage your evolving business challenges.

The AMT-SYBEX Affinity Suite:

- Manages market data flows for over 35 million electricity and gas customers
- Is licensed on 35,000 devices across three continents
- Is licensed for meter data management for over 5 million meter points and growing



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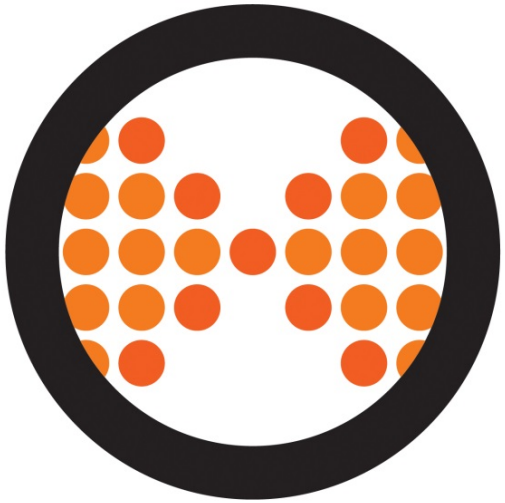
Networkflow™ FOSS

AFFINITY SUITE
networkflow
Network Data Management



- Enabling the **UKPN Smarter Network Storage** project
- Built on **Proven Technology** which currently supports 35 million UK customers
- Network oriented product – pre-packaged with **Network services** and **capacity engine**
- Intelligent algorithms for **demand forecasting** and **optimisation** of energy resources and commercial services
- **Pre-packaged commercial services** managed via user interfaces and calendars
- Integrates with ESS, business applications and the market to provide oversight, validation of **performance, communication and reconciliation**
- **Commercial optimisation** which is flexible, future proof and localised

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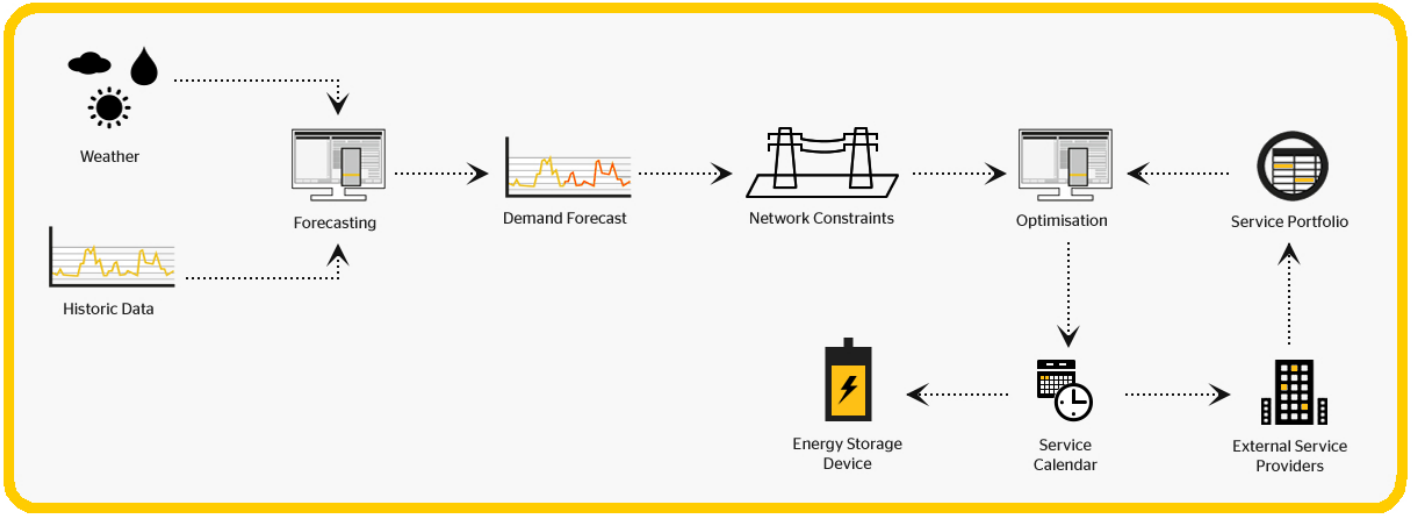
What does our energy storage solution do?

FOSS optimises the value of a storage installation by:

- Forecasting local energy flows
- Accessing and scheduling commercial services
- Managing battery, network and contractual constraints

FOSS automatically determines:

- Optimised schedule of commercial services based on predicted future demand
- Most cost effective battery usage strategy
- Operational capacity now / in future
- Contractual requirements



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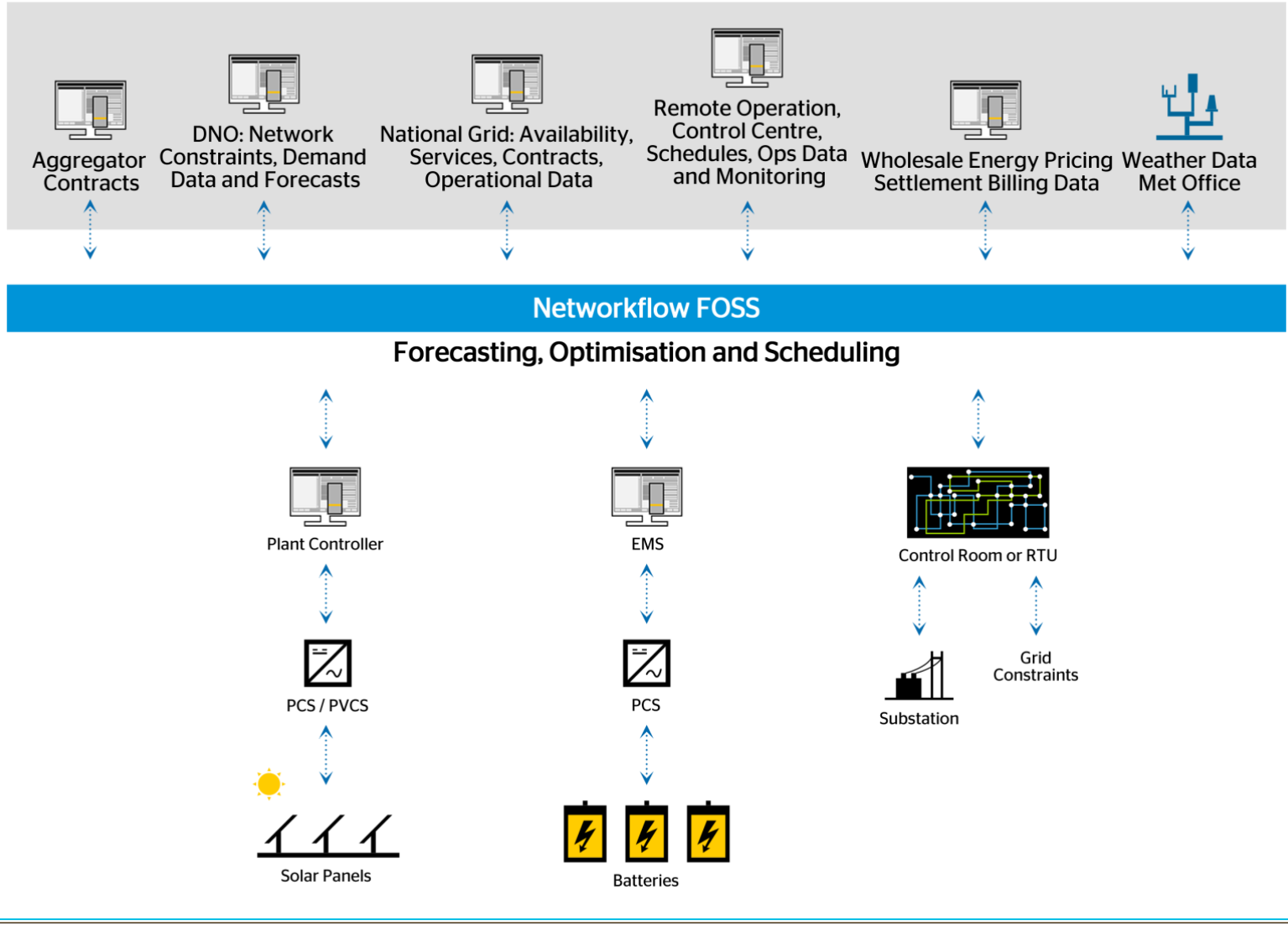

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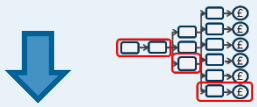
Networkflow FOSS In Use

DNO

Forecast + prioritise network services

Optimise remaining Capacity

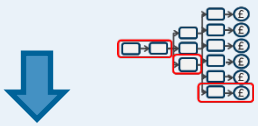


Contract communication and system scheduling

Asset Owner

Forecast network constraints and/or services

Optimise remaining Capacity



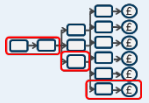
Contract communication and system scheduling

Microgrid Owner

Forecast local generation and demand

Forecast local network constraints and/or services

Optimise remaining Capacity



Contract communication and system scheduling

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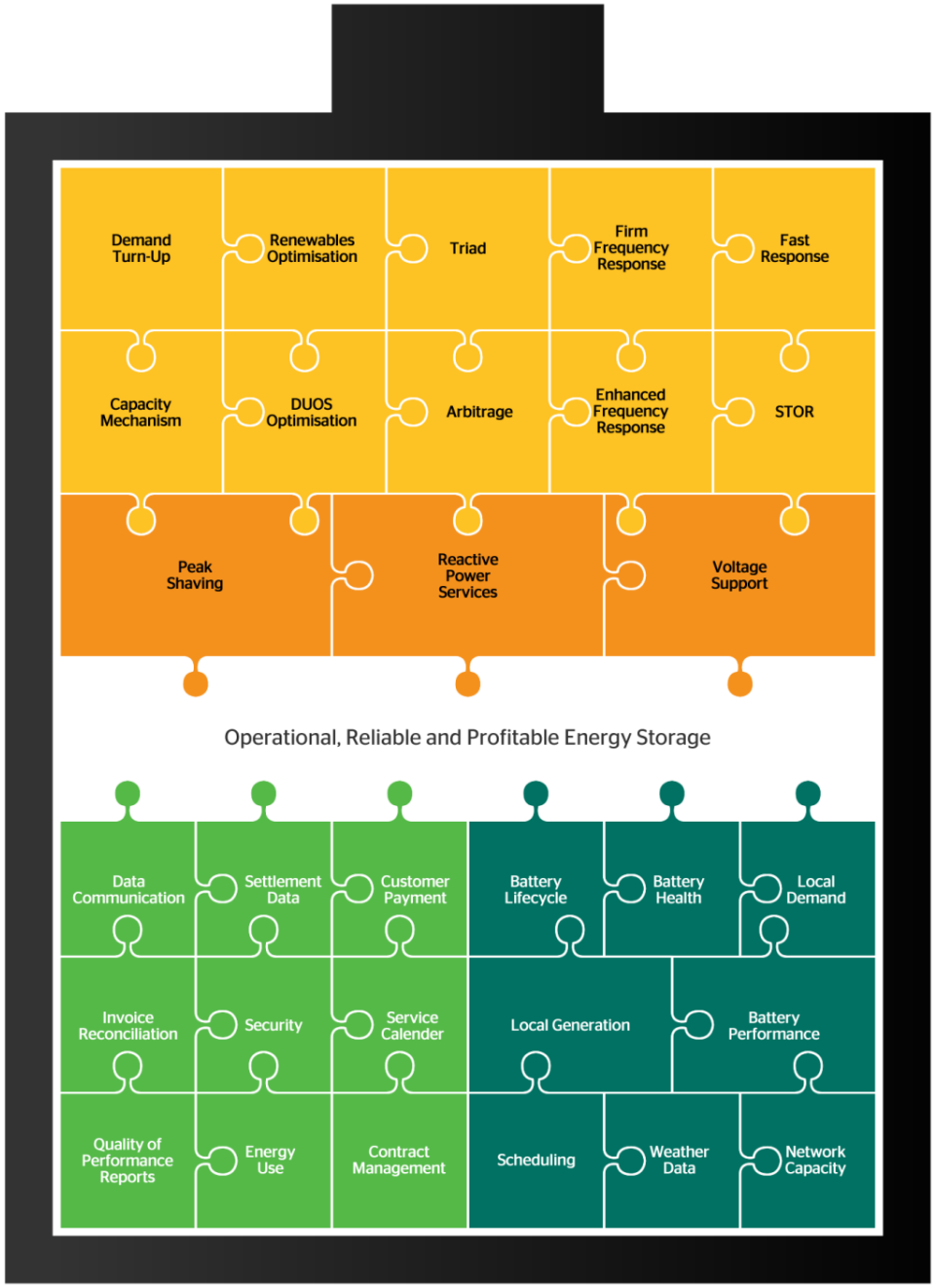
Full optimisation



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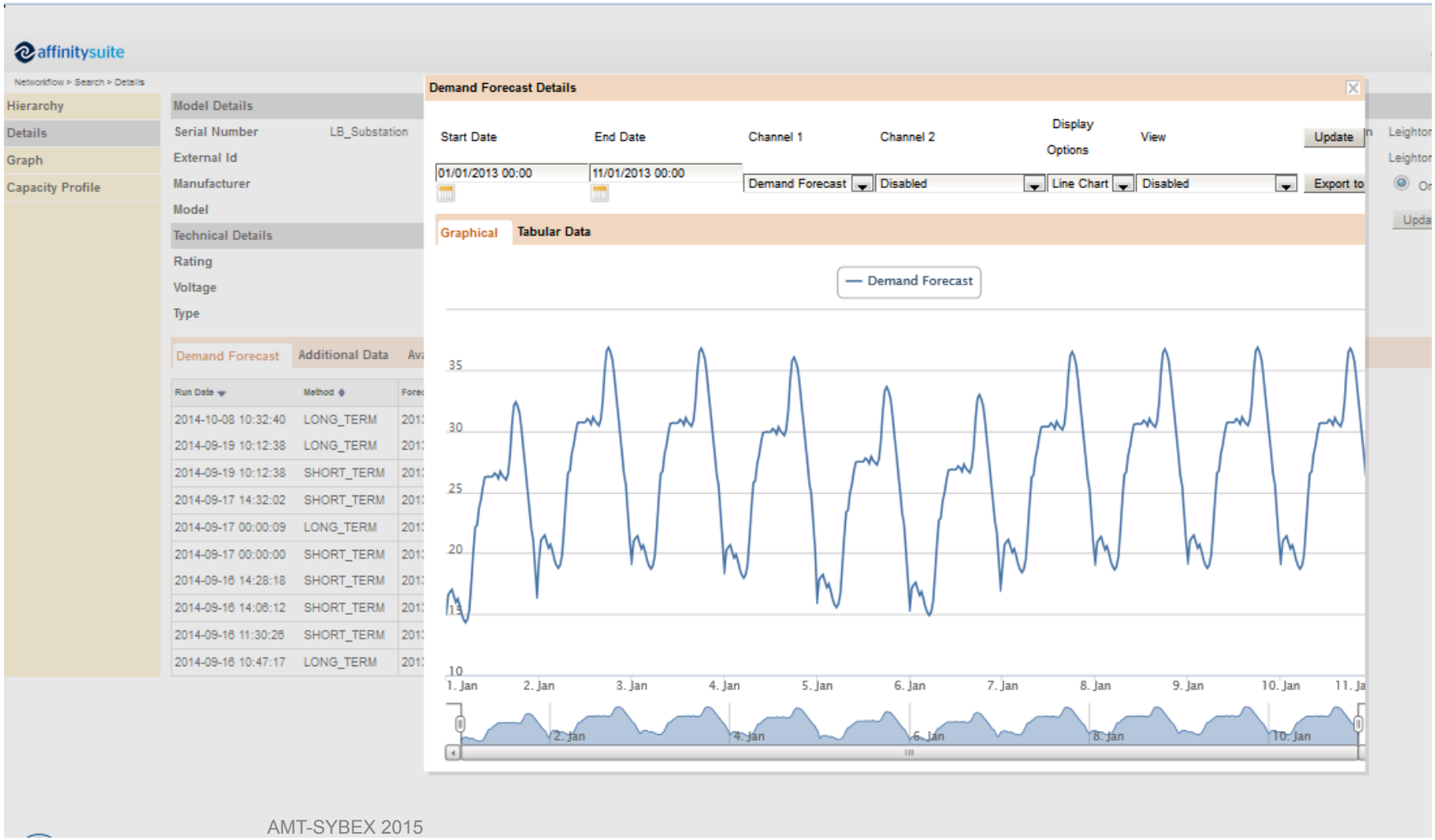
Demand Forecast Function



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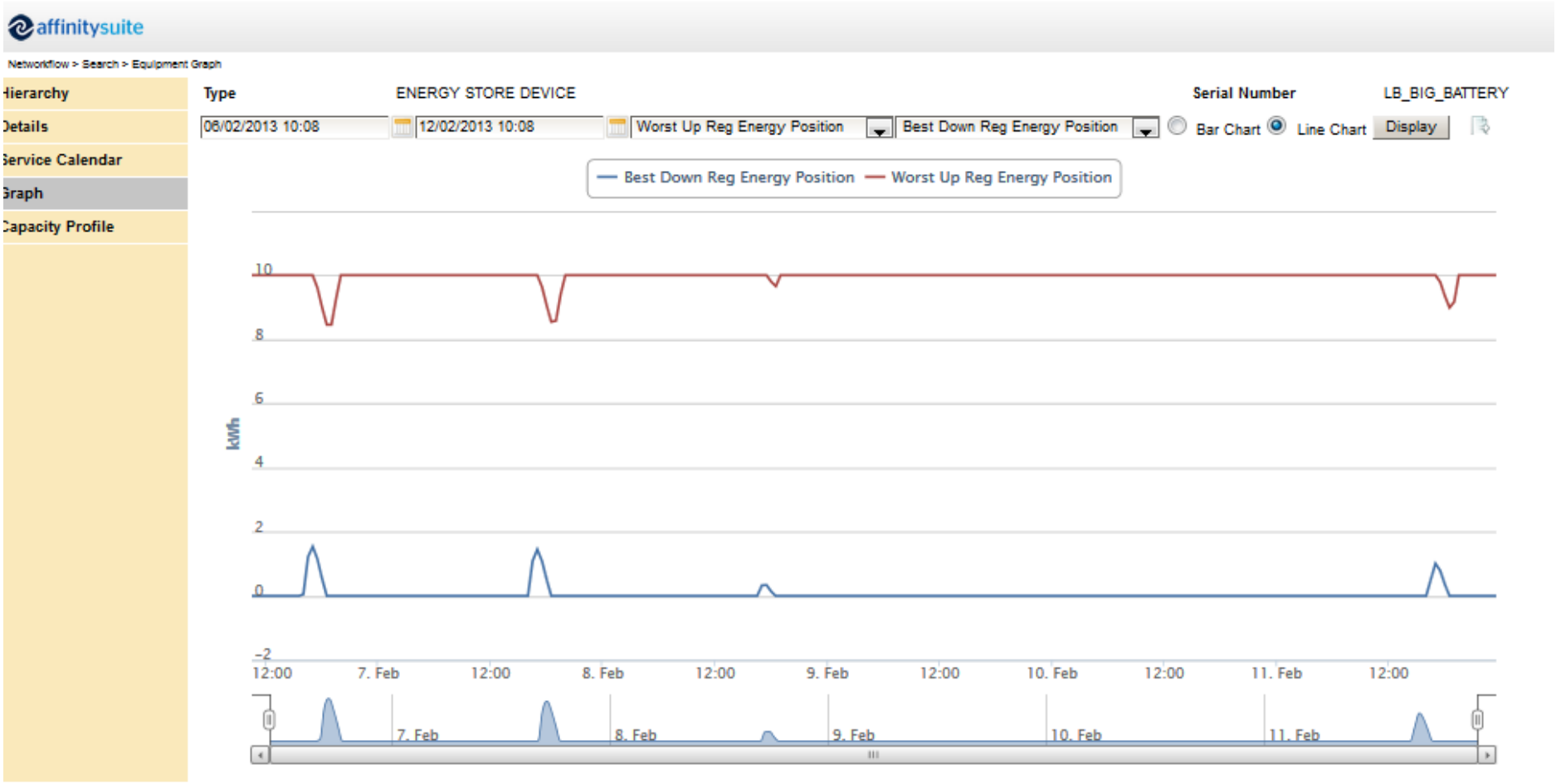
Energy Positions Viewer



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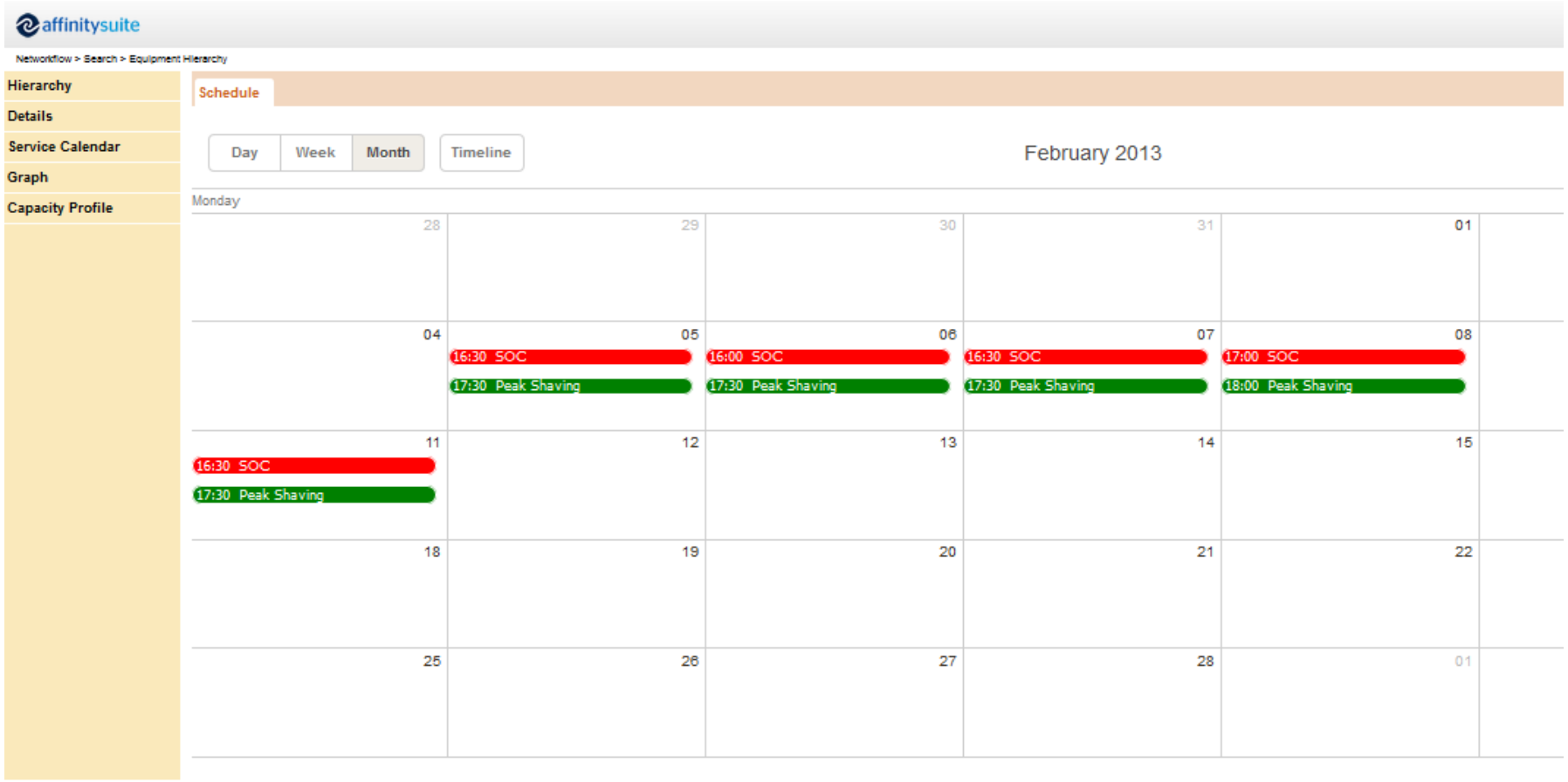
Service Calendar



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FOSS in Use - Smarter Network Storage Project

The Smarter Network Storage (SNS) project installed and is operating an energy storage asset rated at 6MW/10MWh, located in Leighton Buzzard

£13.2m Low Carbon Network Fund funding; £4.0m investment from UK Power Networks

- **Outcomes**
  - Demonstrated multi purpose application of energy storage across full value chain
  - Quantified business model for energy storage – multiple revenues can be “stacked” to improve business case

- **AMT-Sybex**
  Developed optimisation/control system to evaluate access to multiple revenue streams

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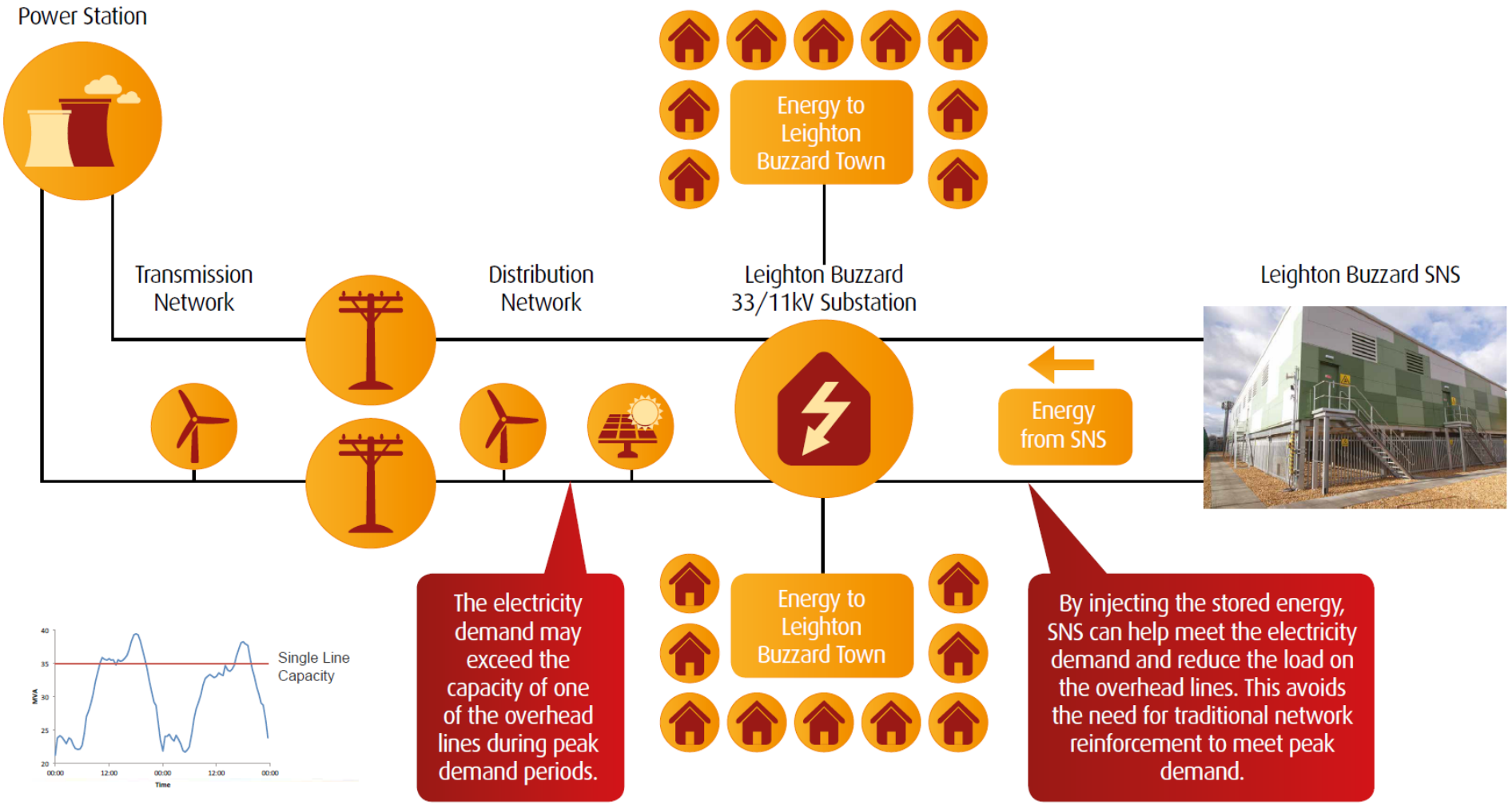
How does SNS Support the Network?



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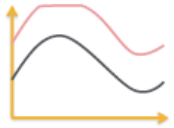
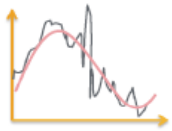
Functions of SNS



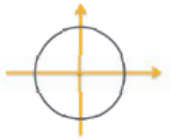
Peak Shaving

SNS uses its stored energy to meet peak demand which reduces the load on the network. This defers the need for network reinforcement to meet peak demand.



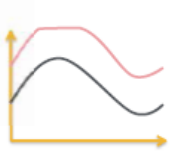
Frequency Regulation

SNS can regulate the grid frequency through power exchanges. This assists National Grid in stabilising the frequency of the wider electricity system.



Reactive Power Support

SNS has 7.5MVAr of reactive power capability. Reactive power can help improve power factor, reduce losses and support voltage levels on the local network.



Reserve

SNS provides reserve capacity and can be triggered remotely to export power. This assists National Grid in balancing electricity demand and supply.

Tolling

SNS can provide energy based on a given energy delivery profile. This can be used to manage imbalance risk and assist in hedging against peak electricity prices.

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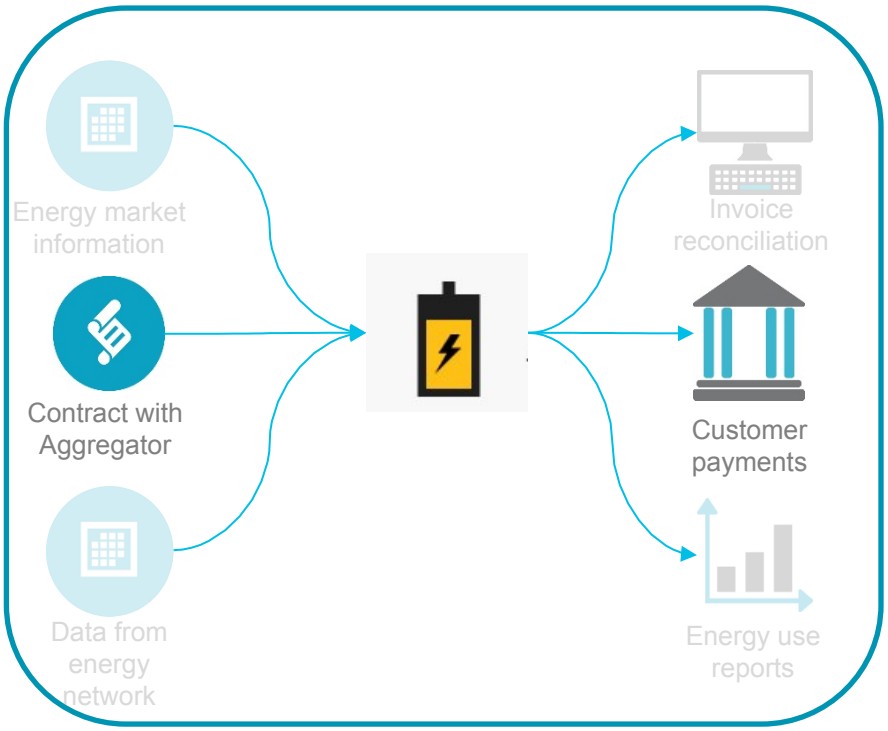
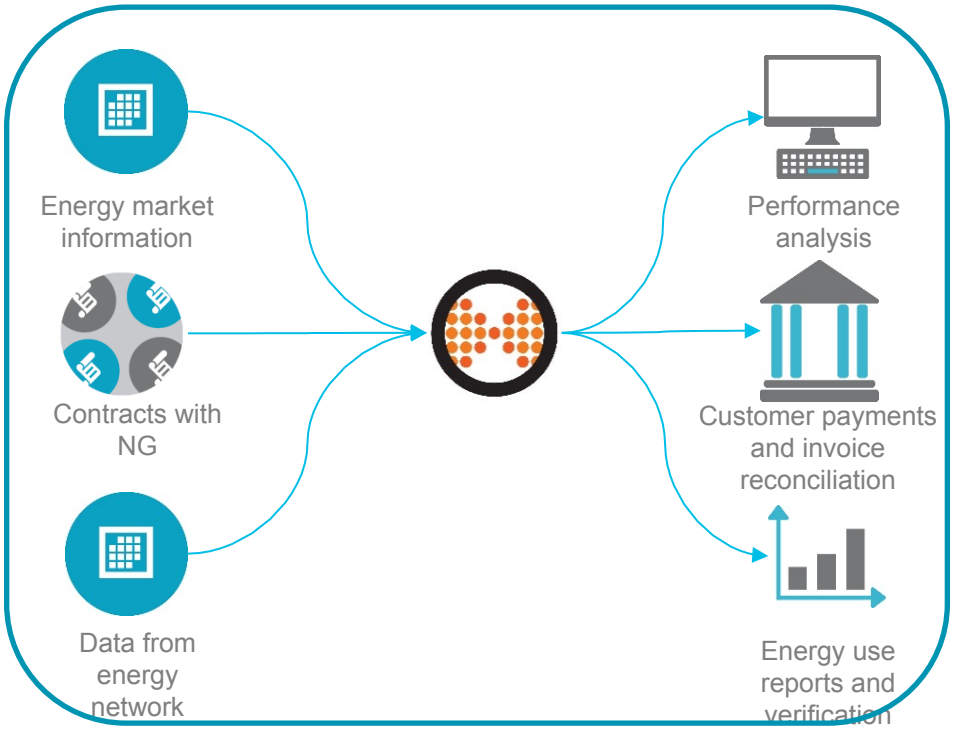
Networkflow FOSS enables storage operators to capitalise on all available revenue streams





All available revenue streams
Visibility
Communication
Optimisation

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Water Companies – Why Energy Storage?

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Water Companies are a significant user of energy

- Peak energy requirement coincides with peak pricing
- On site renewables cannot fully match on site demand
- High carbon impact of operations
- Very high energy bills

There is an opportunity to fully utilise on-site generation against on-site demand

- Relieving high peak time bills
- Replacing carbon intensive peaking plants from the grid
- Whilst maximising the revenue from energy storage

Example site modelling

Full FOSS optimisation:

- Absorbing all exported solar
- Netting off peak time load with stored solar
- Triad Management
- FFR upregulation during peak times (DUOS and supply cost optimisation)
- FFR downregulation during times of solar absorption
- FFR bi-directional when no other constraints

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Storage sizing analysis (2014 data):

Total MVAh per day	Times used	MWh pa
8MWh	2	8
7MWh	6	21
6MWh	16	48
5MWh	32	80
4MWh	60	120
3MWh	82	123
2MWh	124	124
1MWh	190	95
<0.1MWh	268	13.4
MWh pa used	780	632.4

- 8MWh is the minimum requirement to net off exported load on site based on 2014 data.
- MWh's cost money to install, MW's earn revenue.
- Therefore the optimum minimum storage dimensions for the site are 8MW/8MWhrs.

Optimisation key points:

Without FOSS:

- The ability to manage onsite solar becomes too costly in relation to pure FFR operation
- OR FFR revenue is earned ~20% less of the time
- Site DUOS and Supply tariffs are adversely affected

With FOSS:

- The system is in place to support business objectives of managing energy and carbon on-site for water operations – no extra business rates applicable.
- By fully optimising all variables, more revenue is generated than FFR + Triad alone,
- Costs are significantly reduced.

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Example Comparison:

FFR + Triad

IRR 3%

NPV -£299k

Yearly income ~£1.5m

Site running costs increase by £452,000

Breakeven in year 12

Gross Margin – 15yrs £1.26m

Full Optimisation with FOSS

IRR 20%

NPV £5.2m

Yearly income ~£1.5m

Site running costs decrease £126,000

Breakeven in year 7

Gross Margin – 15yrs £8.8m

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DNOs – The case for Energy Storage ownership

March 2016

What does a DNO actually need?

1) A cost effective method of reinforcing the network due to load or generation growth

2) Knowledge of how many hours, MW, and MWhs of support is needed

3) A business case to assess the options, energy storage being one option

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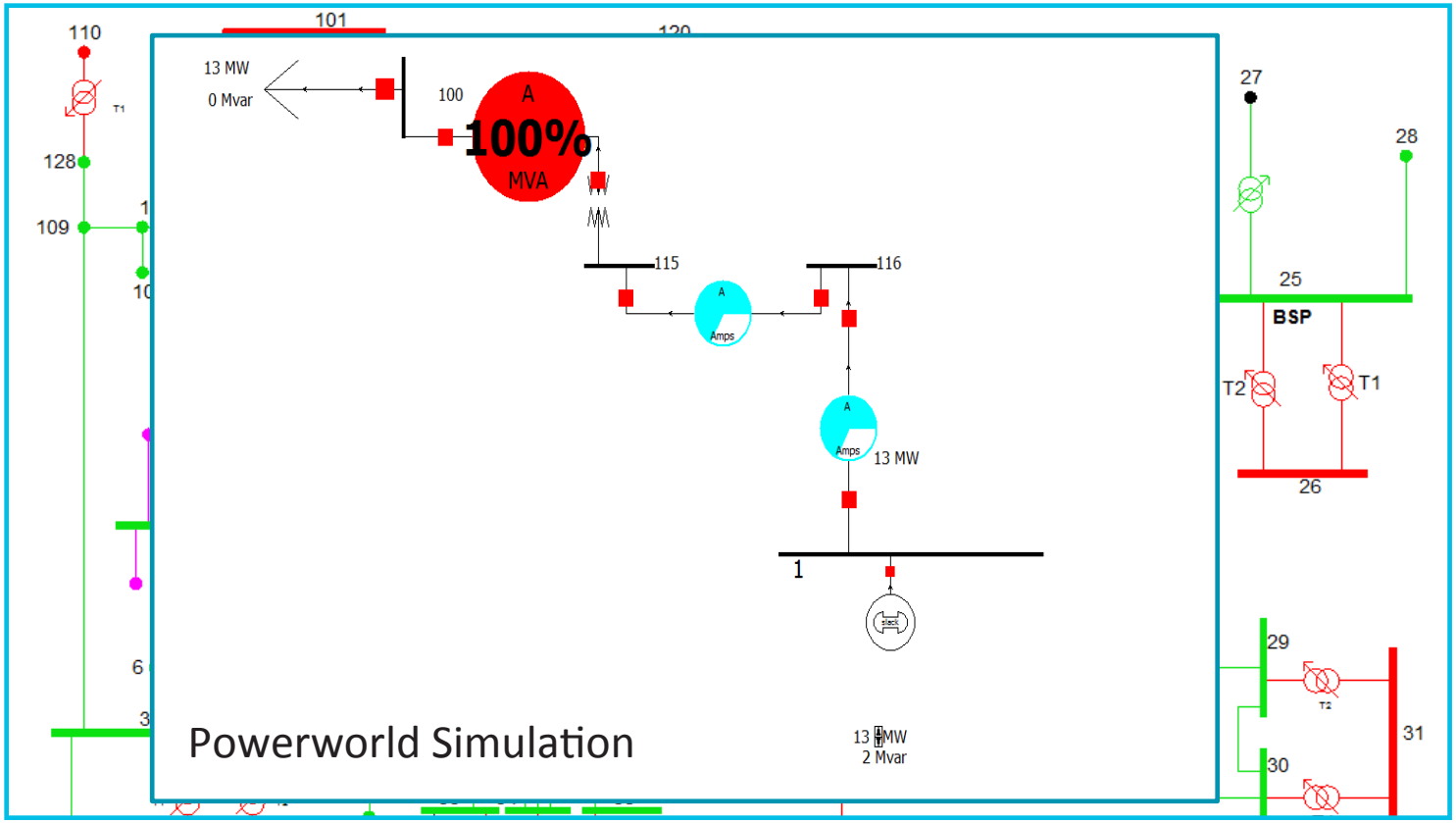
Energy Storage requirements for “bus 100”



Gone Green – all generation	2014/15	2015/16	2019/20	2022/23
PV	5.55	7.03	8.54	11.96
Wind	5.94	7.2	14.6	18.4
Biogas	5	5.1	6.0	7.4

GG – Embedded only	2014/15	2015/16	2019/20	2022/23
PV	5.55	6.83	6.95	7.39
Wind	5.94	7.2	14.6	18.4
Biogas	5	5.1	6.0	7.4

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Method

Forecasting

- Weather data
- Demand data
- Generation data

Optimisation

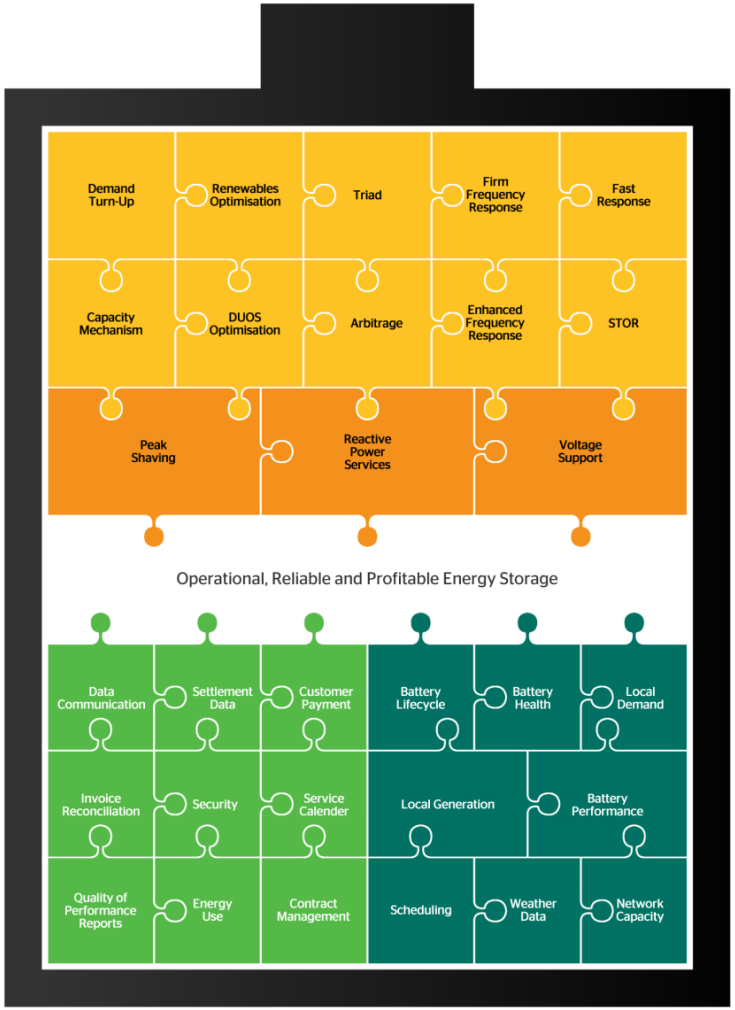
- MW assessment
- MWh
- Hours
- Other services

Scheduling

- Revenue stream assessment
- 48 periods/365 days/15 years

Business Models

- Services
- Ownership



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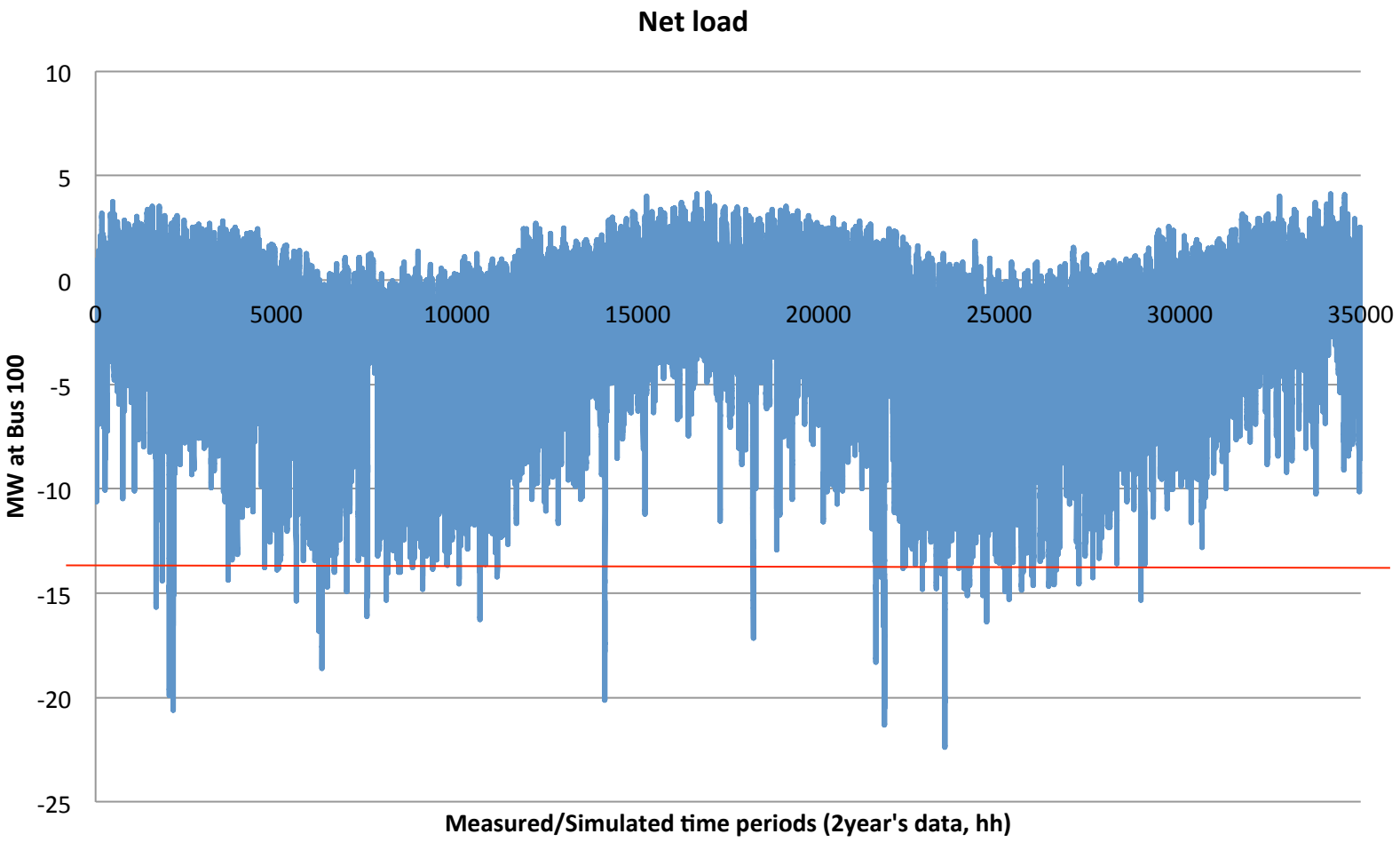
MW Requirement over 2 years – 2022/23 All



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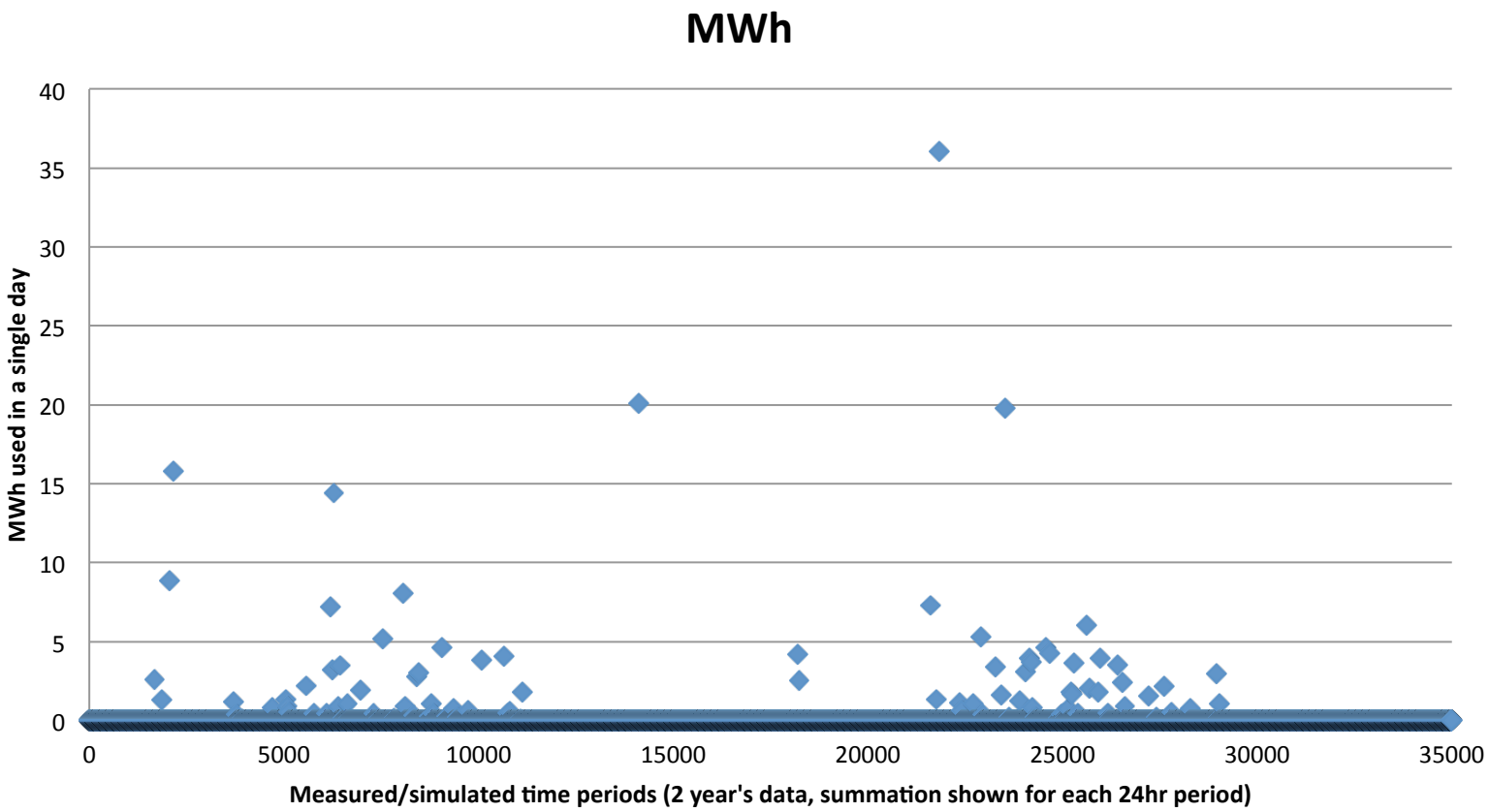
MWh Requirement over 2 years – 2022/23 All



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Examples of analysis – MW and MWh

Total MVAh per day	times used	MWh in period	MWh pa
36MWh	1	36	18
25MWh	0	0	0
24MWh	1	24	12
23MWh	0	0	0
22MWh	1	22	11
21MWh	0	0	0
20MWh	2	40	20
19MWh	1	19	9.5
18MWh	2	36	18
17MWh	1	17	8.5
16MWh	2	32	16
15MWh	2	30	15
14MWh	3	42	21
13MWh	2	26	13
12MWh	3	36	18
11MWh	2	22	11
10MWh	3	30	15
9MWh	2	18	9
8MWh	5	40	20
7MWh	4	28	14
6MWh	6	36	18
5MWh	6	30	15
4MWh	11	44	22
3MWh	16	48	24
2MWh	20	40	20
1MWh	33	33	16.5
<0.1MWh	59	5.9	2.95
MWh pa used	**188**	**734.9**	**367.45**

Total load (MW)	Max	Count	total MWh	Average hrs
0-1MW	9.38	203	475.85	101.5
1MW	8.38	95	198.94	47.5
2MW	7.38	27	49.79	13.5
3MW	6.38	18	28.69	9
4MW	5.38	7	9.41	3.5
5MW	4.38	3	3.28	1.5
6MW	3.38	4.00	3.38	2
7MW	2.38	8	4.75	4
8MW	1.38	2	0.69	1
9MW	0.38	2	0.19	1
10MW	0.00	0	0.00	0
Total MWh to be purchased		**9**	**774.97**	**184.5**

Storage Requirement MW	9	9.0
Storage hours/MWh	4	36
Storage Hours per year	184.5	185
Days used	94	94
Cost DSR	1394954.059	£1,394,954
Cost Storage	278990.8118	£278,991

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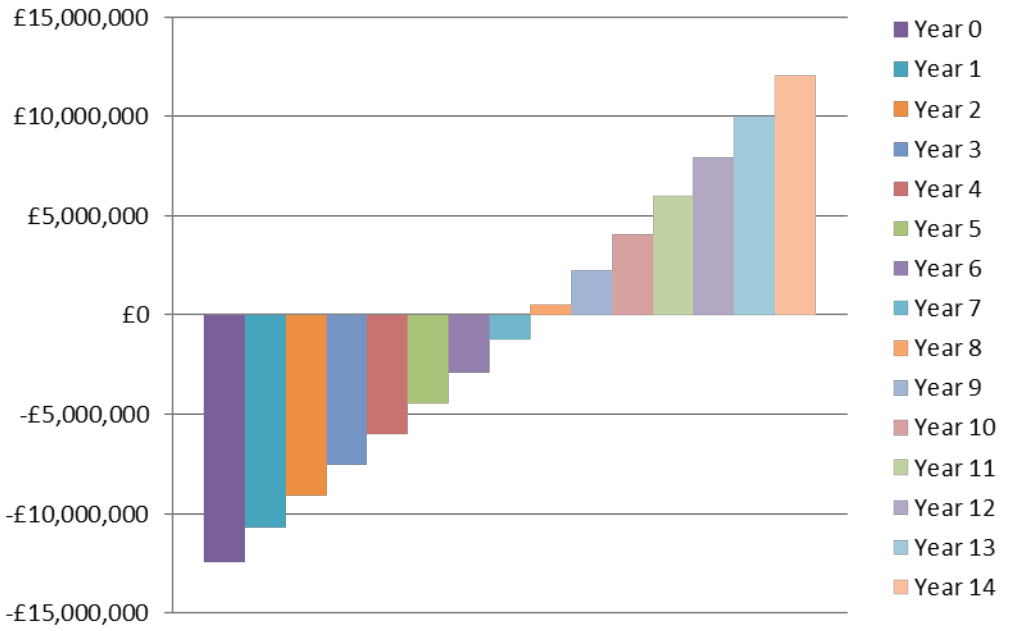
9MW/36MWh

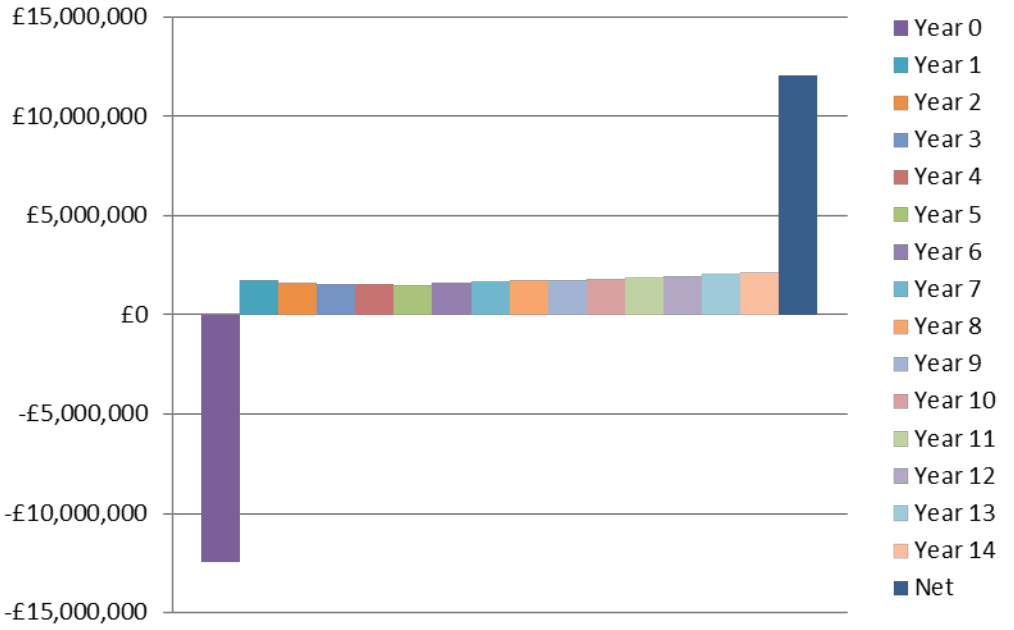
9MW 36MWhrs covers all days

Upfront cost: £12.4m

Payback years: 8

System <10MW and would theoretically fall under derogation limit.





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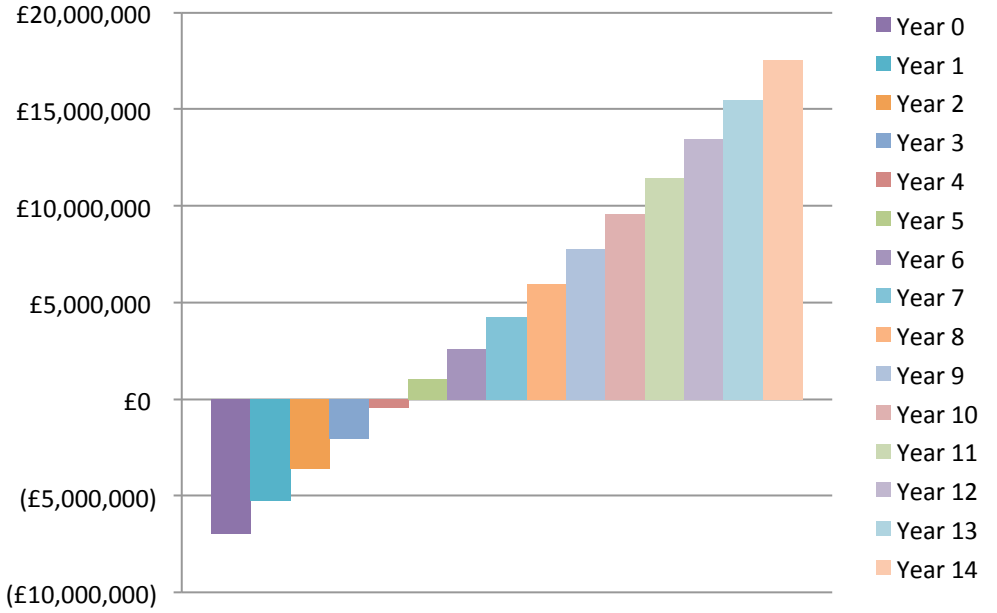
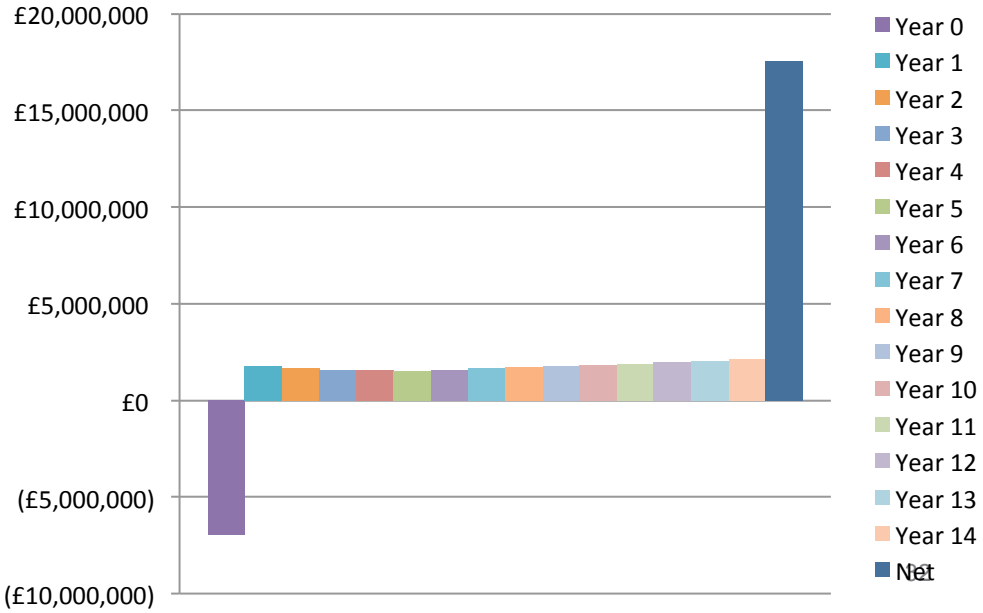
9MW/18MWh

9MW 18MWhrs
Covers 97% days when storage is required
98% of all days

Upfront cost: £6.9m
Payback years: 5

System <10MW and would theoretically fall under derogation limit.





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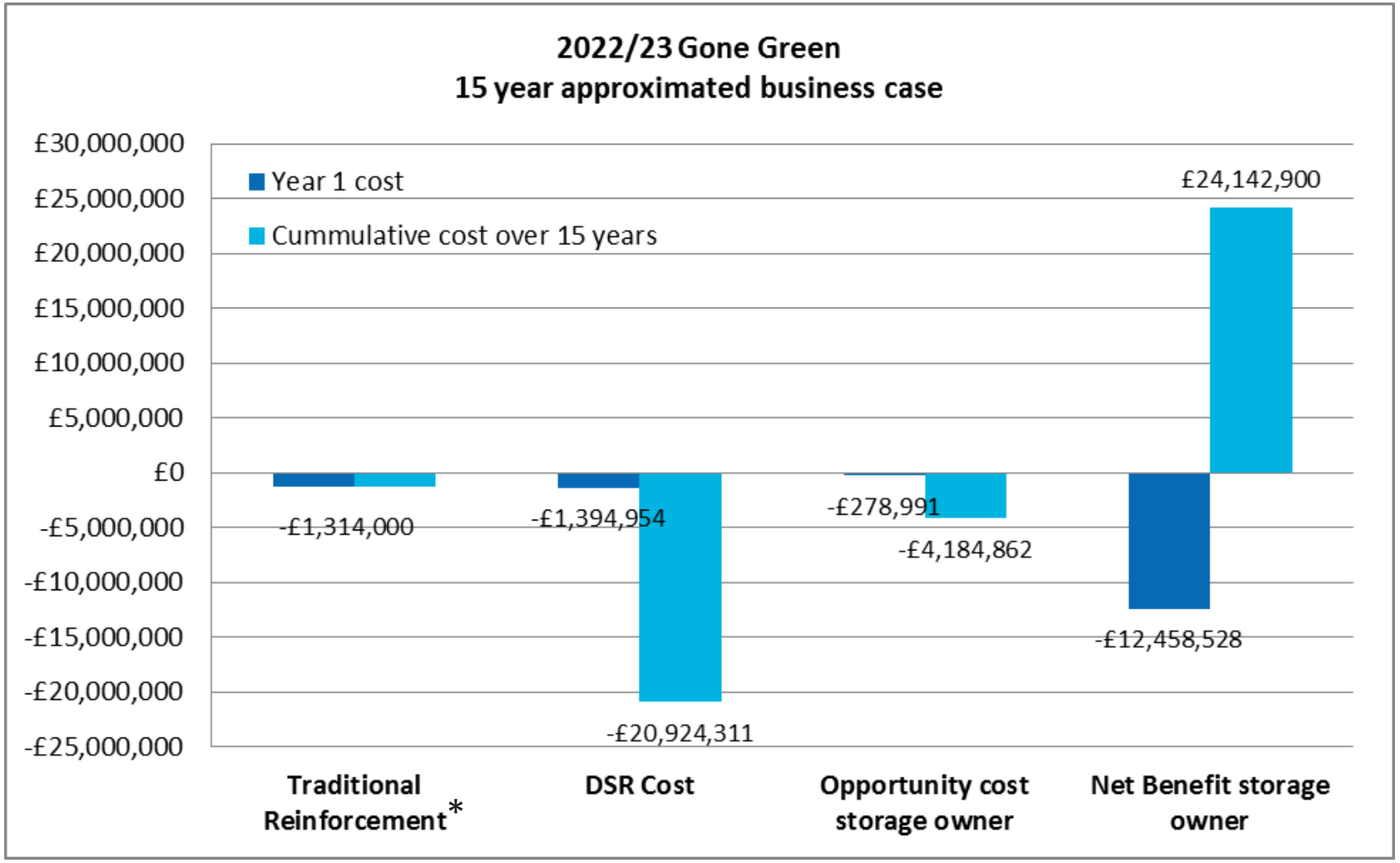
Results



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Summary

Analysis

- Actual expectations for requirements for storage need detailed analysis to be determined for each site and user type

ROI is Key

- Long term ROI can be very attractive
- Long term ROI in some cases is attractive for DNOs yet unattractive to the market

Benefits

- In certain situations storage is the right answer – particularly if the investor receives all the benefits

Systems

- Forecasting is key to efficient ownership and understanding of commercial risks
- Stacking services achieves a cost effective solution for Energy Storage

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Meet the team

John McKeown – AMT- SYBEX Sales Director

Georgina Dingley – Energy Storage Sector Lead

John Hayling – Energy Storage Business Development

Samir Alilat -FOSS Functional Architect

Gordon Brown – Product Manager

AMT-SYBEX has partnered with UKPN Services to provide optimised, end-to-end energy storage delivery.

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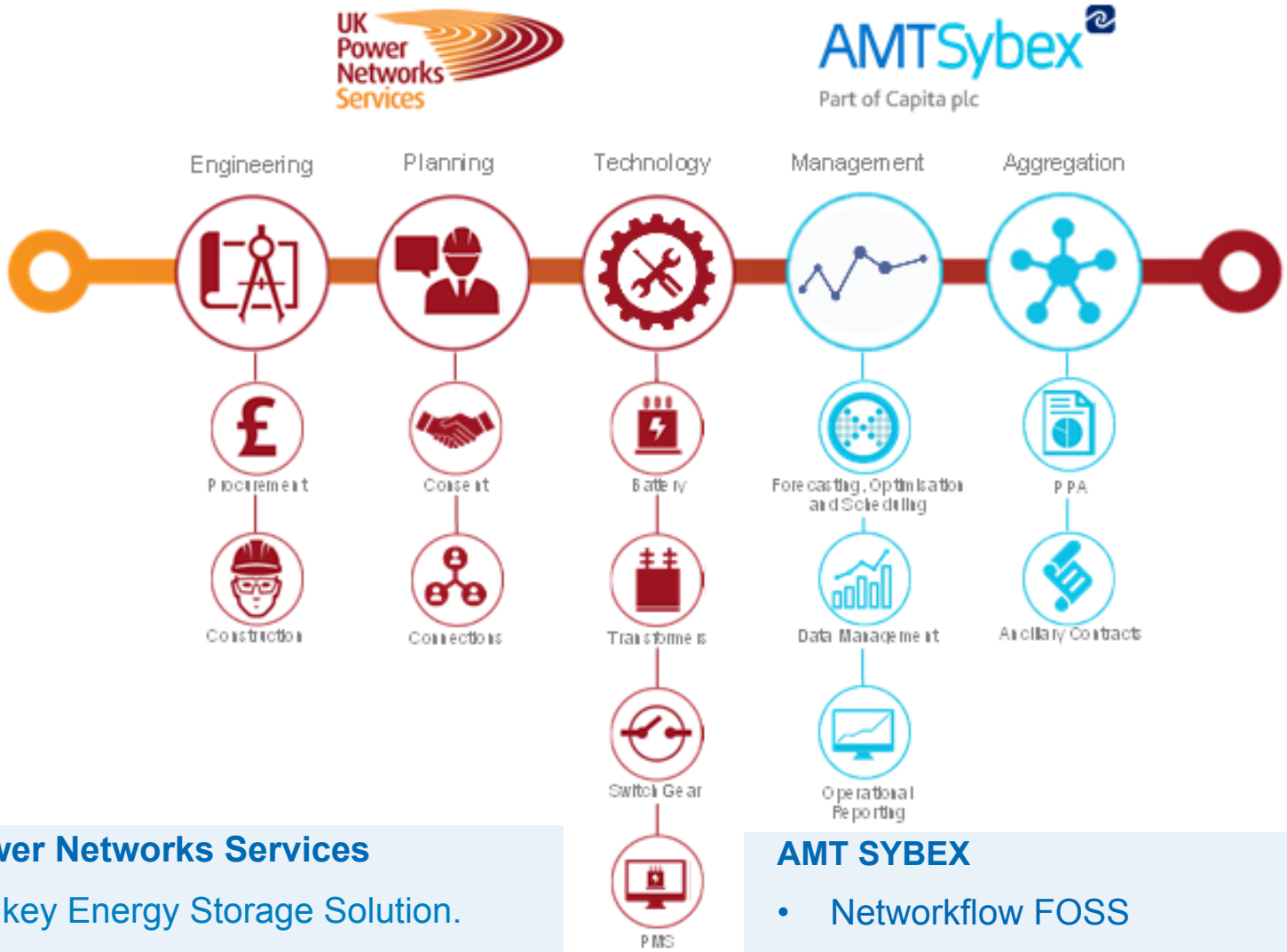

UK Power Networks Services

- Turnkey Energy Storage Solution.
- Containers, transformers, switchboards, SCADA system

AMT SYBEX

- Networkflow FOSS
- Hosted solution, optimisation platform, IT hardware